CHEMICAL & ENGINEERING NEWS

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C&EN

MARCH 14, 1994

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INSTRUMENTATION '94

Pittcon in Chicago showcases new advances Page 32

CHEMICAL & ENGINEERING NEWS
C&EN
MARCH 14, 1994

NEWS OF THE WEEK

- Study finds that investments and technology transfers by U.S. chemical firms in developing nations are deterred by weak intellectual property protection. **Page 6**
- At a Senate hearing, U.S. technology leaders laud R&D subsidy provisions in the recently concluded General Agreement on Tariffs & Trade. **Page 7**
- Researchers caution that widespread use of plants genetically engineered to resist specific viruses could lead to creation of new plant pathogens. **Page 8**
- A Houston jury has ordered 3M and McGhan Medical Corp. to pay about $30 million to three women who claim to suffer ill effects from silicone gel breast implants. **Page 8**
- NASA begins a six-month campaign to study current and potential causes of ozone loss in the Southern Hemisphere, gathering data with aircraft based in New Zealand. **Page 9**
- FMC will begin the first phase of a two-part project that will significantly lower soda ash production costs by use of a new proprietary process. **Page 9**

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BUSINESS

Kenneth Minton, who transformed U.K.'s Laporte from a small bulk chemical company into a thriving specialty chemicals firm, receives Society of Chemical Industry's Centenary Medal. **Page 15**

Potential effects of broad patents on product development are analyzed in context of Calgene's progress toward commercialization of transgenic cotton. **Page 18**

GOVERNMENT

Ethical challenges to health care and technology transfer, presented by rapid advances in biotechnology, were discussed at a conference held at Rice University. **Page 20**

Closing down the Superconducting Super Collider may take four years and more than $1 billion—about half of that amount will go to close existing contracts. **Page 22**

SCIENCE/TECHNOLOGY

Causes and effects of scientific illiteracy are defined and explored by physicist and author James Trefil at a Pittcon '94 plenary session in Chicago. **Page 26**

PRIESTLEY MEDAL ADDRESS

DuPont senior science adviser Howard Simmons focuses on two issues he believes are central to the health of the chemical profession—maintaining a strong basic research effort and improving math and science education. **Page 27**

BOOKS

"Reflections on Symmetry in Chemistry .... and Elsewhere" gives a history of structural chemistry and crystallography as it examines the appeal of the symmetric in chemistry and art. **Page 70**

INSTRUMENTATION '94

Pittcon '94 mirrored a technology in transition, with many of the exhibits reflecting the continuing evolution of approaches to lab automation, growing installation of lab information management systems, and new activity in automated sample preparation. **Page 32**

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Chemical & Engineering News
1155—16th St., N.W., Washington, D.C. 20036

Editor: Michael Heylin (202) 872-4501
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Assistant Managing Editors: James H. Krieger, Janice R. Long, Rebecca L. Rawls, Donald J. Soisson, William J. Storck
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Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600; TDD (202) 872-4432
John Kistler Crum, Executive Director
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Subscription Rates 1994: Printed editions: nonmembers U.S. 1 yr. $115, 2 yr. $207; outside U.S. 1 yr. $152, 2 yr. $281. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3–10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $18. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER: Send address changes to Chemical & Engineering News, Member & Subscriber Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

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LETTERS

CHEMICAL SAFETY

Azide explosions discussed further

Peter G. Urben pointed out that "eschewing halogenated solvents will not eliminate azide explosions" (C&EN, Dec. 13, 1993, page 4). And if we stop reading his letter at this point, he is correct; however, the remainder of the statement and the letter are either incorrect or inappropriate to the facts we described (C&EN, April 19, 1993, page 4).

We cannot speak to the specifics of the explosion described by Victor J. Hruby, Lakmal Boteju, and Guigen Li (C&EN, Oct. 11, 1993, page 2), but in our case, we used a catalytic amount of sulfuric acid and a large excess of sodium azide. The reaction was poured into water and extracted with methylene chloride. After drying and filtering the organic layer, we concentrated it on a rotary evaporator.

The explosion took place after all the solvent had been removed and the flask was being detached from the steam tube. The detonation occurred in the flask; the evaporator was destroyed by the conclusive force of the explosion. We again point to the articles by A. Hassner et al. [*Angew. Chem. Int. Ed. Engl.*, **25**, 479 (1986), and *J. Org. Chem.*, **55**, 2304 (1990)] describing the synthesis and explosive potential of polyazidomethanes.

We believe strongly that diazidomethane and not hydrogen azide was the culprit in our explosion and that Urben should not attempt to change our conclusion. Our intent is to warn our colleagues of the dangers of producing this explosive chemical. We reiterate that because of this incident we no longer permit any chemical reactions with azide to be performed in the presence of a halogenated solvent in our laboratories.

Norton P. Peet
Philip M. Weintraub
Marion Merrell Dow Research Institute
Cincinnati

Nitric oxide reactivity

I would like to compliment Paul L. Feldman, Owen W. Griffith, and Dennis J. Stuehr on their interesting article "The Surprising Life of Nitric Oxide" (C&EN, Dec. 20, 1993, page 27).

However, I would also like to point out that a couple of phrases describing nitric oxide could be misleading. The first paragraph calls "Nitric oxide, NO—a small, relatively unstable, potentially toxic diatomic free-radical." The second paragraph discusses the molecule's reactivity.

In fact, nitric oxide is unusually stable and remarkably unreactive as a diatomic free-radical. Judging by the usual criteria for free-radical activity, nitric oxide does not abstract hydrogens from active hydrogen donors with carbon-hydrogen bonds; does not add to double bonds; does not dimerize or disproportionate extensively, if at all; and reacts relatively slowly with phenolic antioxidants. [See *J. Org. Chem.*, **58**, 3597 (1993) and *J. Chem. Soc. Chem. Commun.*, **18**, 1377 (1993)]. The reactivity of nitric oxide is largely associated with reactions with other radicals, as correctly pointed out by the authors, such as with superoxide anion radical, chelation with transition-metal ion centers such as iron, with oxygen and with phenoxyl radicals. However, in the latter case even radical coupling with nitric oxide-induced EPR line broadening is experienced with phenoxyl radicals as an event separate from chemical coupling, indicating remarkable intrinsic stability and lack of reactivity of nitric oxide in solution.

Although little fundamental reaction chemistry of nitric oxide appears in free-radical textbooks, it appears that nitric oxide may be very similar in stability and reactivity to oxygen (ground- state triplet dioxygen). Oxygen usually does not easily abstract hydrogens from carbon hydrogen bonds (at room temperature), does not add to double bonds, does not dimerize or disproportionate, and reacts relatively slowly with phenolic antioxidants. The reactivity of oxygen is mostly associated with reactions with other radicals or paramagnetic species although in the former case this reaction can also be reversible. Of course, nature knew of this similarity between oxygen and nitric oxide for a long time. How else could these two small molecules do the many wonderful things we expect them to do in biological systems?

Edward G. Janzen
Director, National Biomedical Center for Spin Trapping & Free Radicals
University of Guelph, Guelph, Ontario

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INTELLECTUAL PROPERTY RIGHTS

Risk cuts flow of investment, technology

Investments in developing nations and transfers of technology to them by U.S. companies are heavily influenced by the strength or weakness of a nation's intellectual property protection, particularly in high-technology sectors like the chemical and pharmaceutical industries.

This finding—documenting with survey data, interviews, and statistical analysis what some observers had previously hypothesized—stems from a research project initiated by the International Finance Corp. (IFC), an affiliate of the World Bank and the largest multilateral source of loan and equity financing for private-sector projects in developing countries. The 51-page study was supported by the World Bank and prepared by Edwin Mansfield, director of the Center for Economics & Technology and professor of economics at the University of Pennsylvania.

"It's the first reasonably comprehensive, systematic study done," Mansfield tells C&EN. "There've only been partial studies with a bit of data in the past, and a lot of anecdotal accounts."

In 1991, Mansfield began to survey 100 major U.S. firms in six manufacturing industries: chemicals (including drugs), transportation equipment, electrical equipment, machinery, food, and metals. He obtained complete or partial data from 94 companies, a high response rate; 16 chemical firms participated, although not all answered all questions.

The effect of intellectual property protection depends greatly on the type of investment, the study finds. Only about 20% of the 94 firms say such protection is important for investment in sales and distribution outlets. For investment in rudimentary production and assembly facilities—involving basic technologies well known to firms in the industry—about 30% call protection important. About 50 to 60% say protection is important for investment in facilities to manufacture components or complete products, and some 80% call protection important for investing in R&D facilities.

Weak patent protection deters U.S. chemical firms overseas

	% deterred		
	Joint-venture investment[a]	Technology transfer[b]	Licensing[c]
DEVELOPING NATIONS			
Argentina	40%	44%	62%
Brazil	47	50	69
Chile	31	47	47
Hong Kong	21	21	33
India	80	81	81
Indonesia	50	40	73
Mexico	47	31	56
Nigeria	64	67	73
Philippines	43	47	47
Singapore	20	12	25
South Korea	33	31	38
Taiwan	27	19	44
Thailand	43	60	73
Venezuela	40	50	62
OTHER NATIONS FOR COMPARISON			
Japan	7	0	12
Spain	0	0	6

Note: Based on sample of 16 U.S. chemical and pharmaceutical firms for 1991 (not all firms supplied data for all countries). a Percent reporting that protection is too weak to permit investment in joint ventures with local partners. b Percent reporting that protection is too weak to permit transfer of their newest or most effective technology to wholly owned subsidiaries. c Percent reporting that protection is too weak to permit licensing of their newest or most effective technology to unrelated firms. **Source:** International Finance Corp. study by Edwin Mansfield

For investments other than in sales and distribution outlets by the six industries, the chemical industry has the highest percentage of firms that consider protection to be important. As might be expected, a high correlation exists between the industries' rank in this regard and their rank in previous studies on the importance of patents in the innovation process.

Mansfield asked each firm to indicate for 14 developing nations whether their intellectual property protection is too weak to permit three activities: investment in joint ventures with local partners (including contribution of advanced technology); transfer of its newest or most effective technology to wholly owned subsidiaries; or licensing of its newest or most effective technology to unrelated firms.

He selected the 14 nations because of their size and importance, as well as the frequency of their citation in controversies over intellectual property protection. For comparison's sake, the study added a developed country whose protection has aroused some controversy (Japan) and a relatively poor West European nation (Spain).

More than 30% of the U.S. firms believe intellectual property protection in India, Nigeria, Brazil, and Thailand is too weak to permit investment in joint ventures. Only 10% or fewer view Japan and Spain that way. The chemical industry, where patents are relatively important, generally shows the highest percent deterred—racking up figures of 80%, 64%, 47%, and 43%, respectively, in the four nations, for example. The metals industry generally has the lowest percent deterred (20%, 20%, 0%, and 0%, respectively).

Similarly, 30% or more of the firms say they would be unlikely to transfer their newest or most effective technology to a wholly owned subsidiary in India, Thailand, or Nigeria, but fewer than 5% react this way in regard to Japan and Spain. The chemical industry again has the highest percent deterred and the metals industry, the lowest. For instance, the percentage of chemical firms deterred reaches 81% for India, 67% for Nigeria, 60% for Thailand, and 50% for Brazil and Venezuela.

As for licensing a firm's newest or most effective technology to unrelated firms, more than 30% of the companies polled would be deterred from doing so in India, Brazil, Thailand, Nigeria, Indonesia, and Taiwan. Fewer than 10% view Japan and Spain that way. More than two thirds of the chemical firms say

protection is too weak to permit such licensing in India (81%), Indonesia (73%), Nigeria (73%), Thailand (73%), and Brazil (69%).

Averaged over all six industries, nations perceived to have the weakest protection are India, Thailand, Brazil, and Nigeria. Those seen to have the strongest protection are Hong Kong and Singapore. Hong Kong and Singapore also rate best in the chemical industry.

Mansfield points out that there is a high correlation among a nation's standing in the three activities. Moreover, he notes, results for the chemical and pharmaceutical industry jibe with a Pharmaceutical Manufacturers Association list of countries with weak intellectual property protection.

Interviews conducted during the study with company officials cast more light on the results. For example, firms object to lack of patent protection for chemicals and drugs in India, Thailand, and Brazil. They also give poor ratings to Argentina (which denies patent protection to drug products) and Venezuela (which has denied patent protection to drug products or chemical preparations, reactions, and compounds). Chemical executives point out that chemical firms in these countries often can imitate new products relatively easily, a much harder task for companies in such industries as metals and transportation equipment.

An unidentified "president of a large chemical firm" explains that "intellectual property protection is especially important for those proprietary advanced technologies we have spent millions to develop, and which we feel provide the basis of our global competitive advantage. . . . The weaker we perceive a country's system for protecting intellectual property to be, the more likely we are not to transfer any leading-edge technology, whether through direct investment, joint venture, or license."

The study points out that steps have been taken recently to strengthen intellectual property protection in several nations, including South Korea, Mexico, and Taiwan. For example, a chemical company chairman says Mexico's 1991 law "can serve as a role model for many other countries." Mansfield reinterviewed some firms to see if attitudes are changing. So far, only Mexico shows a substantial rise in the percent of firms willing to transfer advanced technology: About 30% have changed their stand.

Copies of the report, "Intellectual Property Protection, Foreign Direct Investment, and Technology Transfer," IFC Discussion Paper 19, are available for $6.95 plus postage from the World Bank Publications Department, 1818 H St., N.W., Washington, D.C. 20433, or by calling (202) 473-1155.

Richard Seltzer

U.S. high-tech leaders laud GATT R&D clauses

The final draft of the General Agreement on Tariffs & Trade (GATT), approved last December in Geneva and top-heavy with impenetrable trade jargon, has begun moving through the Senate Finance Committee. Last week, a committee hearing aired reactions to the pact's once-controversial R&D provisions.

Those provisions had set off last-minute fireworks during the December trade talks (C&EN, Jan. 3, page 13). After frantic negotiations in Geneva, the U.S. delegation succeeded in convincing the other negotiators that it didn't really want what it had apparently supported for many months: limits on government support for research with industry or for research tied to industrial needs in government or academic labs. The whole caper underscored the perceptual mismatch between trade and technology policymakers in both the Clinton and Bush Administrations.

C&EN staff photo

Bloch: ensure green light stays off

Judging by testimony at the hearing from former National Science Foundation director Erich Bloch and from Mary L. Good, undersecretary for technology at the Commerce Department, things are now just hunky-dory.

Bloch, a distinguished fellow at the private Council on Competitiveness in Washington, D.C., says three improvements in the final draft stand out. First, it makes "clear and appropriate distinctions between fundamental research, industrial research, and commercial development research." These definitions are important because the U.S. wants to ensure that the green light stays off for government subsidies for development projects. The U.S. position always has been that development should be done only by the private sector.

Second, fundamental research is free from any limits at all. The earlier draft's language "was vague and imprecise," Bloch notes, while the new text's definitions and perspectives "are clear and specific."

Third—and this is probably the most crucial change—the new draft removes the requirement that subsidy recipients tell GATT overseers, up front, the objectives of research to be supported. Bloch points out that such a requirement would have "revealed to the GATT Subsidies Committee their research plans and technology road maps." U.S. companies prefer to keep their plans to themselves.

But Bloch admits that a couple aspects of the GATT draft still concern the Council on Competitiveness. "If abused," he says, these provisions "could conceivably cause adverse effects on our industries." The GATT organization must closely monitor the so-called green-light provision to see whether foreign competitors of U.S. firms are providing large subsidies for major projects like Airbus—the passenger airliner whose development subsidized by the French and British governments still causes rancor in the U.S. The result, he adds, could be distortion of markets. And "some of the provisions for pre-competitive development activity may be interpreted differently or even abused by other countries."

Rufus H. Yerxa, deputy U.S. trade representative, pledged at the hearing that the subsidies section will not become a "loophole under which other countries will be able to provide production or marketing subsidies."

Good also is pleased with the GATT pact. The Commerce Department's Ad-

SSC termination will be lengthy and expensive

Closing down the huge Superconducting Super Collider (SSC) is going to take a lot of time and money. Congress gave the Department of Energy $640 million to begin the shutdown in fiscal 1994, and DOE is asking for another $180 million next year. In the meantime, Energy Secretary Hazel R. O'Leary has come up with a termination plan for the project that will guide the department's activities.

Much of the expense associated with terminating the SSC project involves closing out the many contracts the department has for building and supplying the site. Other major parts of the termination will be the environmental restoration and asset closeout, and the benefits provided for the SSC's employees. Two things still unresolved are the settlement DOE must make with Texas for the state's investment in the project and deciding what will be done with the facilities already there.

Congress voted last year to close down the project as of October 1993. The consensus was that costs had escalated beyond reason and that the nation had other priorities for the funds. Originally thought to cost about $4.4 billion to build, the estimated cost had ballooned to $13 billion by last year. More than $2 billion had already been spent. Congress had also been told significant funding would come from other nations, especially Japan, to help with the project. However, only very minor funding was ever forthcoming from foreign sources, and Japan did not contribute at all.

Over the next four years, DOE plans to spend more than $210 million to close out the contracts and subcontracts it negotiated for building the SSC. The six major engineering contractors at the site are EG&G, PB/MK, GD-CDM, Babcock & Wilcox-CQM, Lockheed, and Westinghouse. These firms held combined contracts worth about $850 million at the time SSC was halted. Overall, the project has approximately 44,000 contracts out for everything from business cards to the manufacture of the superconducting magnets. There are also real estate leases and some international agreements that have to be completed.

PB/MK was the construction contractor at the site, responsible for the tunnels, buildings, and utilities for the SSC. Paul H. Gilbert, project director for the PB/MK team, says: "I think everyone was terribly disappointed" that Congress shut off funding for the project. "We are also disappointed because our part of the job had been going extremely well." The company had fixed-price contracts to spend $460 million, and at the time of termination was running nearly $100 million under budget, according to Gilbert. Despite already having a termination plan from DOE, Gilbert expects it to take up to two years before all the contract settlements are completed.

Taking care of personnel being laid off at the site is a major concern as well. About 2,200 persons, including scientists and engineers, worked in the laboratories at the site. According to DOE's SSC spokesman James Abbee, that number is already down to about 1,100, and likely will be reduced to 950 by the end of this month.

DOE is committed to providing outplacement assistance programs, job fairs, and other aid for workers who have been dismissed. DOE also will give 60 days' severance pay for those laid off at the laboratory. Most of the technical people—scientists, engineers, and computer specialists—are able to find work fairly quickly, Abbee says, but clerical personnel are having more trouble.

Gilbert indicates a similar situation at his company. "Placement has been a substantial problem," he says. His company is rapidly reducing staff, but has only been able to find new jobs within the company for about half of the people. The rest are finding positions at other companies or away from the site, with about 10 to 15% remaining unemployed, Gilbert says.

The question of how best to use the assets from the SSC site is to be the subject of a meeting March 22 at the SSC central facility. Interested parties are invited to suggest new uses for the facilities and equipment now in place. The SSC site already includes extensive cryogenic facilities; superconducting magnet tooling equipment; the Magnet Test Laboratory; a 550,000-sq-ft building including machine shops, labs, and liquid helium refrigerator; 15 miles of tunnels; and an integrated network of distributed computer workstations. Also at the site are a negative hydrogen ion source and the first stage of a 2.5-MeV linear accelerator.

"Secretary O'Leary has to report back to Congress by July 1 with recommendations as to what to do with the SSC assets," Abbee says. That does not give DOE much time. Texas Gov. Ann W. Richards has formed an advisory panel to advise her on future use of the site, and the panel is discussing ideas with DOE, too, according to Abbee.

A major expense to the government not included in the estimate of the termination plan is reimbursing Texas for the money it has spent at the site. Texas and DOE have signed an agreement to negotiate in good faith on this issue. Texas claims it has spent $435 million directly on the SSC and has said that it wants to be reimbursed for that amount, in cash. "This is being negotiated at this time," Abbee says. Adding this amount to the amount already spent and projected termination costs would raise the government's tab for halting the SSC to more than $1.1 billion.

David Hanson

Contractors take biggest chunk of funds for Superconducting Super Collider termination

$ Millions	1994	1995	1996	1997	Total
Contract closeout	$141.4	$ 66.6	$ 3.7	0	$211.7
Personnel demobilization	71.3	17.2	1.9	$ 0.3	90.7
Technology closeout	33.9	2.0	0	0	35.9
Facility maintenance & security	22.6	10.5	0	0	33.1
Administration & support	17.6	13.5	0.7	0.7	32.5
Asset phaseout[a]	11.0	8.2	57.8	57.6	134.6
Environmental safety	7.7	7.6	0	0	15.3
Economic development & use	3.6	1.5	0	0	5.1
TOTAL	$309.1	$127.1	$64.1	$58.6	$558.9

Note: Cost estimates do not include $51 million spent in fiscal 1993, nor do they include future settlement with Texas. a Includes site restoration. **Source:** Department of Energy